DOCUMENT RESUME

ED 098 559 CS 001 502

AUTHOR	Levin, Joel R.; And Others
TITLE	A Further Comparison of Imagery and Vocalization Strategies in Children's Discrimination Learning. Technical Report No. 299.
INSTITUTION	Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	TR-299
PUB DATE	May 74
CONTRACT	NE-C-00-3-0065
NOTE	14p.
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	*Cognitive Processes; Concept Formation; *Discrimination Learning; Educational Research; Elementary Education; Learning Processes; *Perception
IDENTIFIERS	Imaging; Vocalizing

ABSTRACT

Three experiments were conducted to determine the effectiveness of verbal and imaginal rehearsal strategies in children's discrimination learning. With verbal materials, imaging the referent of the correct item was more facilitative than vocalizing the correct item, as long as the former strategy was defined in a manner conducive to effective imagery generation. In fact, when children engaged in such a strategy, their verbal discrimination performance was virtually error-free. No difference between the two strategies was found in pictorial discrimination learning, both resulting in performance very near ceiling. A possible interpretation of the results is provided. (Author)

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

ED 098559

Technical Report No. 299

A FURTHER COMPARISON OF IMAGERY AND VOCALIZATION STRATEGIES IN CHILDREN'S DISCRIMINATION LEARNING

by

Joel R. Levin, Elizabeth S. Ghatala,
Thomas M. DeRose, Larry Wilder, and
Richard W. Norton

Report from the Project on
Children's Learning and Development

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
Madison, Wisconsin

May 1974

CS 001 502

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the National Institute of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education and no official endorsement by that agency should be inferred.

Center Contract No. NE-C-00-3-0065

ED 098559

Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

CS 001 502

Acknowledgments

We are grateful to the staffs and students of Wisconsin elementary schools in Cambridge, Mount Horeb, and Belleville for their cooperation.

Table of Contents

		Page
	Abstract	vii
I.	Introduction	1
II.	Experiment I	3
III.	Experiment II	7
IV.	Experiment III	9
V.	Conclusions	11
	References	13

List of Tables

Table		Page
1	Mean Number of Correct Discriminations out of 24, By Experimental Condition (Experiment I).	4

Abstract

Three experiments were conducted to determine the effectiveness of verbal and imaginal rehearsal strategies in children's discrimination learning. With verbal materials, imaging the referent of the correct item was more facilitative than vocalizing the correct item, as long as the former strategy was defined in a manner conducive to effective imagery generation. In fact, when children engaged in such a strategy, their verbal discrimination performance was virtually error-free. No difference between the two strategies was found in pictorial discrimination learning, both resulting in performance very near ceiling. A possible interpretation of the results is provided.

I
Introduction

There is now considerable evidence documenting the importance of subject-generated mediational strategies in children's learning (see, for example, Levin, in press, and Rohwer, 1972). However, while most of the research has focused on such cognitive strategies in associative-learning and comprehension tasks, recent studies have extended these investigations to an even more fundamental type of learning, namely discrimination learning (Levin, Ghatala, Wilder, & Inzer, 1973; Wilder & Levin, 1973).

In a discrimination learning task, S must learn which item in each of several pairs is "correct," as arbitrarily specified by E. Successful performance on the task is commonly attributed to a "frequency" differential between correct and incorrect items (cf. Ekstrand, Wallace, & Underwood, 1966), resulting primarily from S's rehearsal of the correct item during the informative feedback phase of the task. Consistent with this view, when Ss are given explicit instructions to rehearse the correct item, performance is generally facilitated in comparison to that obtained from Ss left to their own devices (e.g., Underwood & Freund, 1968; Wilder, 1971), with the effect being especially noticeable in children (Wilder & Levin, 1973), i.e., in Ss who are not likely to employ an effective rehearsal strategy spontaneously.

Two popular rehearsal strategies which have been investigated to date have consisted of vocalizing the correct item or imaging its referent. Although it has been argued that imagery is a superior strategy in adults (Row & Paivio, 1971), a recent study with children found no significant difference between the two (Levin et al., 1973). The purpose of the present series of experiments was to explore this latter result more fully: in particular, to determine the comparative effectiveness of children's verbal and imaginal strategies with different types of learning materials (viz., pictorial and verbal).

II
Experiment I

Method

Subjects

The Ss consisted of 84 fifth and sixth grade students from a semirural Wisconsin community. All Ss were randomly assigned in equal numbers to the six experimental conditions, and were individually tested in a small private room located in the school building.

Design and Materials

Two 24-pair discrimination lists were constructed, one consisting of pictures and the other of the printed verbal labels corresponding to the pictures. These two lists were crossed with three kinds of pre-learning instructions: control, vocalization, and imagery. In the control condition Ss were instructed to remember the correct item in each pair. The Ss in the vocalization condition were instructed to pronounce the correct word (or the correct picture's label) aloud three times during the feedback phase; and Ss in the imagery condition were instructed to form a visual image of the correct picture (or the referent of the correct word) during the feedback phase.[1]

The pictures consisted of 48 artists' line drawings of common objects approximately 2 to 3 inches in size on a white background. The words consisted of the most common verbal labels of the pictures and were typed in primary type on a white background. The stimuli were randomly paired, and then mounted on cardboard pages (one pair per page) and inserted into looseleaf binders.

Procedure

The Ss were told that they would be shown pairs of pictures (or words) and would be expected to remember the stimulus in each pair that was marked with a star, so that when they were shown the two unstarred stimuli later they could pick out the previously starred one. An example was provided in conjunction with the rehearsal instructions already described. Two anticipation trials were then administered. On each trial, two unstarred items appeared for five seconds followed by a five-second feedback interval, where the two items appeared in the same position but with one of them (randomly determined) having a star beneath it. Following this, the next two items appeared in the same manner, until all 24 pairs had been exposed. During the first trial, Ss were required just to study the items carefully (and, where appropriate, to rehearse the correct item during the feedback phase). On Trial 2, when the first unstarred pair appeared, Ss were required to choose (by pointing) which of the two items had previously had the star beneath it. Feedback was then provided, as on the first trial, and then the next unstarred pair appeared for S to make a choice.

The pairs were presented in a different random order on each trial. Right-left placement of the correct stimuli was also random from trial to trial, with the restriction that there be an equal number of correct stimuli on each side of the page for each trial. Number of correct choices on Trial 2 (the response trial) constituted the dependent variable for the analysis.

---

[1]The three-to-one vocalization-imagery difference follows previous procedures, and serves to equate rehearsal times in the two conditions.

Results and Discussion

Table 1 presents the mean number of correct choices in each of the six experimental conditions. Analysis of these data (with instructions nested within materials) revealed that pictures produced more correct responses than words ($F = 20.52$, $df = 1/78$, $p < .001$), as has been noted several times previously (e.g., Rowe, 1972; Wilder & Levin, 1973). Of primary interest here, however, were instructional differences, which were significant for both words ($F = 11.57$, $df = 2/78$, $p < .001$) and pictures ($F = 14.84$, $df = 2/78$, $p < .001$). The pattern of differences varied within each, as determined by Tukey ($\alpha = .05$) comparisons: within words both vocalization and imagery produced significantly greater performance than control, with no differences between the former two; within pictures, however, vocalization was superior to both imagery and control, the latter two not differing significantly.

Consistent with previously reported children's discrimination learning results, vocalization and imagery constituted similarly effective rehearsal strategies when the stimulus materials consisted of words (cf. Levin et al., 1973). However, when pictures were employed imagery was no longer facilitative whereas vocalization still was. While it might be tempting to argue on the basis of these data that: (1) vocalization and imagery strategies are equally effective with verbal materials; and (2) imagery is not an effective rehearsal strategy with pictorial materials, the following propositions were first considered.

If facilitation is assumed to result from a strategy's providing distinctive cues that in some way add "frequency" to the correct item (which in turn serves to increase the "frequency" differential between correct and incorrect items), then in the present experiment it may be seen that: (1) vocalization of the correct item provided unique articulatory and acoustic encoding cues for Ss in the case of both words and pictures; whereas (2) imaging the referent of the correct item provided S with a unique imaginal encoding for words, but not for pictures (where the image of the picture would be redundant with the picture itself). Compounding this is the possibility that Ss were following instructions more faithfully in the vocalization conditions (where an overt response was produced for each item) than in the imagery conditions (where no overt response was required)--a problem we have noted previously (Levin et at., 1973). However, it would appear that such discrepancies between the two strategies could be eliminated by externalizing S's imagery rehearsal, as is true with S's vocalizations.[2]

Indeed, this notion follows directly from Piaget's theorizing about the nature of visual imagery, which is assumed to have its roots in the child's playing and drawing activity (Piaget & Inhelder, 1971). Since recent experimental evidence demonstrates the efficacy of externalizing imagery processes in children's associative learning (e.g., Danner & Taylor, 1973; Wolff & Levin, 1972), we attempted to adapt the same tactic to the discrimination learning paradigm.

---

[2]Of course, an alternative approach is possible, namely to reduce the effectiveness of a vocalization strategy by making it covert. We have recently conducted such a study and found this to be the case.

TABLE I

MEAN NUMBER OF CORRECT DISCRIMINATIONS OUT OF 24, BY EXPERIMENTAL CONDITION (EXPERIMENT I).

	Control	Vocalization	Imagery
Words	16.43	20.64	19.00
Pictures	20.64	23.57	18.79

Consequently, 28 additional Ss from the population of Experiment I were recruited and administered the discrimination task (half receiving the pictorial list and half the verbal list). During the feedback phase of the task, overt imagery rehearsal consisted of Ss' turning their heads to the side and tracing the outline of the correct picture (or the correct word's referent) in the air in front of them, while visualizing their constructed responses. In the example, the amount of time spent by Ss in doing this was made to be comparable to that of Ss in the previous rehearsal conditions (i.e., about five seconds). In all other respects, the procedures were identical to those of Experiment I.

With both pictorial and verbal materials, the overt imagery strategy produced virtually errorless performance (averages of 23.71 and 23.86 respectively out of 24). For pictures, overt imagery rehearsal is comparable to the vocalization rehearsal of Experiment I ($|t| < 1$); whereas for words, overt imagery is superior to vocalization ($t = 4.54$, $df = 26$, $p < .001$). Thus, motor-induced imagery appears to constitute a highly effective discrimination learning strategy, just as it does in children's associative learning (Levin, in press). And, at least with regard to the discrimination learning of words, it appears to be more effective than overt vocalization of the correct item. However, in order to determine whether the latter effect can be explained solely in terms of greater motor activity and S involvement in the case of overt imagery than in the case of vocalization, a second experiment was conducted.

III
Experiment II

The 24-pair word list of Experiment I was utilized, and Ss were tested under one of four pre-learning instructions: control, vocalization, and overt imagery as discussed previously.[3] In addition, another condition was included wherein Ss were instructed to "write" the correct word with their finger in the air in front of them, while visualizing their constructed responses (writing imagery). If the fantastic performance of overt imagery Ss is due primarily to the motor activity per se, then the performance of writing imagery and overt imagery Ss should be comparable and superior to that of vocalization Ss. If, on the other hand, the imagined referent of the word is primarily responsible, then performance of Ss in the overt imagery condition should be superior to that of Ss in both verbal conditions (vocalization and writing imagery).

In order to make efficient use of the data (based on 29 sixth graders randomly divided among the four experimental conditions), three planned comparisons were formulated and tested according to Dunn's procedure with the experimentwise error set equal to .05 (Kirk, 1968). The mean numbers of correct responses of 17.14, 19.25, and 22.86 in the control, vocalization, and overt imagery conditions compare very favorably with the corresponding verbal discrimination data of Experiment I (16.43, 20.64, and 23.86 respectively). In addition, the average performance of Ss in the writing imagery condition (19.86) was indistinguishable from that of Ss in the vocalization condition ($|t| < 1$). Overt imagery was significantly superior to the two combined, however ($t = 2.82$, $df = 25$), as well as to the control condition ($t = 4.18$, $df = 25$).

The data of Experiment II therefore support the notion that motor activity per se is not the primary mechanism underlying the superior performance of overt imagery Ss. Rather, the process is most beneficial when the activity is related to image construction (of the picture or the word's referent). On the other hand, writing imagery appears to be an alternative strategy to vocalization, in that in each case a unique verbal rehearsal of the correct item (writing it or overtly verbalizing it) is provided (see also O'Brien & Carmean, 1967, who arrived at a similar conclusion with adults).

While it appears unequivocal that overt imagery is the most effective rehearsal strategy yet encountered in children's verbal discrimination learning, the comparable data for the pictorial discrimination task are less than satisfying due to the potential ceiling effect in the vocalization and overt imagery conditions (23.57 and 23.71 correct respectively out of 24). For this reason, a final experiment was conducted using a much longer list in order to see whether differences among strategies would then be revealed.

---

[3] In this experiment, however, Ss in the vocalization condition pronounced the correct item only once.

IV
Experiment III

The pictorial list of Experiment I was expanded to be 36 pairs in length. Thirty sixth-grade children were assigned in equal numbers to three experimental conditions: control, vocalization, and overt imagery. The procedures correspond percisely to those employed in Experiment I.

Control Ss correctly discriminated an average of 29.30 out of the 36 pairs (or about 81% correct in comparison to 86% correct on the 24-pair list of Experiment I). Astonishingly, however, once again the performance of both vocalization and overt imagery Ss was nearly error-free (averages of 35.40 and 35.60 respectively, with perfect performances turned in by five out of ten Ss in the vocalization condition and seven out of ten Ss in the overt imagery condition).

V
Conclusions

Although previous research into adults' verbal discrimination learning has identified overt verbalization of the correct item as a facilitative rehearsal strategy, it has recently been suggested by Rowe and Paivio (1971) that imaging the referent of the correct item is even more facilitative. The present data support this assertion in children's verbal discrimination learning, as long as the strategy is defined in a manner conducive to effective imagery generation. In this regard, performance under overt imagery rehearsal was so efficient that it served to obliterate the typical advantage that pictorial materials enjoy over verbal materials in discrimination tasks (see, for example, Wilder & Levin, 1973, as well as the control conditions of Table I here).

Whereas overt imagery is more effective than vocalization in children's discrimination learning of words, both appear to be comparably effective strategies for pictorial discrimination learning. Although several theoretical accounts of these findings are possible--one being Paivio's (1971) "dual-coding" hypothesis, which may be stretched to fit various aspects of the present data--our current interpretation of the results (stemming from a host of investigations under different paradigms) is simply that the success of a particular rehearsal strategy depends on the degree to which relevant cognitive processes are activated in the learner.

In the case of overt imagery, such processes are activated with both pictures and words: with pictures, as a result of the constructive activity required to reproduce the picture from memory;[4] with words, as a result of both this constructive activity and the initial interpretive activity required to "get from" the printed word to its object referent. In the case of vocalization, however, while spoken production of a picture's label requires some degree of interpretation, the spoken production of a printed word does not. Indeed, it might be argued that the benefits of vocalization rehearsal with words are due primarily to attentional, articulatory, and/or acoustic effects rather than to the constructive or interpretive cognitive activity invested by the learner. And while previous data of our own are certainly consistent with this position (Levin et al., 1973; Wilder & Levin, 1973), some experiments currently in progress will hopefully evaluate it more directly and in greater detail.

---

[4]Piaget regards this as a necessary component of drawing; and it even more aptly characterizes our Ss' behavior, in that they were required to turn their heads away from the stimulus during construction.

References

Danner, F. W., & Taylor, A. M. Integrated pictures and relational imagery training in children's learning. Journal of Experimental Child Psychology, 1973, 16, 47-54.

Ekstrand, B. R., Wallace, W. P., & Underwood, B. J. A frequency theory of verbal-discrimination learning. Psychological Review, 1966, 73, 566-578.

Kirk, R. E. Experimental design: Procedures for the behavioral sciences. Belmont, California: Brooks/Cole, 1968.

Levin, J. R. What have we learned about maximizing what children learn? Theoretical Paper No. 49. Wisconsin Research and Development Center for Cognitive Learning, Madison, in press.

Levin, J. R., Ghatala, E. S., Wilder, L., & Inzer, E. Imagery and vocalization strategies in children's verbal discrimination learning. Journal of Educational Psychology, 1973, 12, 85-90.

O'Brien, G. L., & Carmean, S. L. Verbalizing and writing as auxiliary responses during discrimination learning. Psychonomic Science, 1967, 9, 335-336.

Paivio, A. Imagery and verbal processes. New York: Holt & Co., 1971.

Piaget, J., & Inhelder, B. Mental imagery in the child. New York: Basic Books, 1971.

Rohwer, W. D., Jr. Decisive research: A means for answering fundamental questions about instruction. Educational Researcher, 1972, 1, 5-11.

Rowe, E. J. Discrimination learning of pictures and words: A replication of picture superiority. Journal of Experimental Child Psychology, 1972, 14, 303-312.

Rowe, E. J., & Paivio, A. Imagery and repetition instructions in verbal discrimination and incidental paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 668-672.

Underwood, B. J., & Freund, J. S. Two tests of a theory of verbal-discrimination learning. Canadian Journal of Psychology, 1968, 22, 96-104.

Wilder, L. Spoken rehearsal and verbal discrimination learning. Speech Monographs, 1971, 38, 113-120.

Wilder, L., & Levin, J. R. A developmental study of pronouncing responses in the discrimination learning of words and pictures. Journal of Experimental Child Psychology, 1973, 15, 278-286.

Wolff, P., & Levin, J. R. The role of overt activity in children's imagery production. Child Development, 1972, 43, 537-547.

GPO 000-044-0